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Description

CAP SUSPENSION DEVICE

Cross Reference to Related Applications

[0001] The present application is a continuation patent application of International Application No. PCT/SE02/01229 filed 20 June 2002 which was published in English pursuant to Article 21(2) of the Patent Cooperation Treaty, and which claims priority to Swedish Application No. 0102466-0 filed 9 July 2001. Both applications are expressly incorporated herein by reference in their entireties.

Background of Invention

Technical Field

[0002] The present invention relates to a device for suspension of a cab on a vehicle frame. The invention is intended in particular for construction machinery and contractor's machinery, the cab suspensions of which are subjected to relatively great stresses.

Background Art

[0003] Construction machinery/contractor's machinery such as, for example, wheel loaders and dumpers place considerable demands on the cab suspension construction. In order to make the working environment of the driver comfortable, the suspension must be capable of reducing/eliminating the relatively powerful vibrations and shocks which are otherwise transmitted from the vehicle frame to the cab. Moreover, for reasons of safety, the suspension must be sufficiently strong to retain the cab on the frame even if the vehicle should overturn. In this context, reference is frequently made to ROPS protection, where ROPS stands for Roll Over Protection Structure.

[0004] Conventionally, rubber has been included in the suspension construction in order to reduce the transmission of vibrations from frame to cab. In a traditional construction, the cab rests on a vibration element, usually taking the form of a "rubber collar" which is adapted for a through-type connecting means such as, for example, a bolt which connects the cab to the vehicle frame. The element of the suspension which serves for taking up load is usually arranged on the bolt under the vehicle frame. An example of a construction of this type is disclosed, for example, in US 5064242. A disadvantage of this type of construction is

that "rubber collars" do not meet current high requirements for vibration insulation/vibration damping.

[0005] In order to improve vibration-related characteristics, the utilization of what is known as "viscous mounts" or "hydro mounts" has become increasingly more common in suspension devices in recent years. Such vibration elements usually contain a viscous liquid, for example oil, which is used in order to reduce transmission of shocks and vibrations. A number of different alternatives have been proposed in functional solutions with the aim of combining the strength characteristics and vibration-damping characteristics of such suspension devices. An example is provided in EP 669484.

[0006] In most cases, the vibration-related and shock-related prevention characteristics are entirely adequate as far as elements of the "viscous mount" type are concerned, but the general problem is that strength characteristics are often limited. A known solution is to construct the vibration-damping element so that it meets prescribed strength requirements. The problem is then that the strength requirement has to be established once and for all because this requirement has a major influence on the manufacturing process. It is then difficult to adapt the

construction to new circumstances. Another disadvantage of this solution is that the elements are relatively expensive.

[0007] Another solution is to make new attachment points and to mount one or more extra fastenings between the vehicle frame and the cab, parallel to (in front of, behind or at the side of) the vibration-damping element, in order to meet the strength requirements. The problem of this type of functional solution is that it requires considerable space and additional work for mounting and demounting, especially when the new attachment points require portions of the cab and/or the vehicle frame to be reinforced.

SUMMARY OF INVENTION

[0008] An object of the present invention is to provide a cab suspension arrangement/construction that provides good vibration-damping/insulating characteristics and, compared to known solutions, provides a simplified procedure for adaptation, mounting, demounting and exchange of the component elements for absorbing vibration and strength.

[0009] In at least one embodiment, the present invention takes the form of a device or arrangement for establishing the suspension of a cab on a vehicle frame. The arrangement

comprises (includes, but is not limited to) a first element adapted mainly for reducing transmission of shocks/vibrations from the vehicle frame to the cab, and a second element adapted mainly for taking up load in the event of, for example, accident situations. The first and second elements are serially arranged in the general vertical direction with respect to the vehicle, and the device comprising means for connecting the cab and the vehicle frame, and the first and second elements are arranged on this connecting means. In one respect, the invention is characterized by the fact that the first element is connected firmly in the vehicle frame, or alternatively in the cab, and that the connecting means is connected firmly to the first element and the cab, or alternatively to the vehicle frame. Ultimately, in this embodiment, the connecting means constitutes a firm connection between the first element and the cab, or alternatively the vehicle frame.

[0010] The cab and the vehicle frame are thus firmly connected to one another via the first element and the connecting means, which first element can be mounted on either the vehicle frame or the cab. This construction makes it possible for a first element with good vibration-damping and vibration-insulating characteristics, for example a first el-

ement of the "viscous mount" type which is not adapted for a through-type connecting means, to be integrated in a suspension device comprising two different elements with different main functions, where both the first and the second element can, owing to the serial arrangement, act in the same attachment point between the cab and the vehicle frame. This in turn results in the device, according to the invention, being less bulky than conventional elements if arranged in parallel, and also affords the possibility of minimizing the number of attachment points between the cab and the vehicle frame. This construction also makes it possible to combine in the suspension device a relatively sophisticated first element with a relatively simple and robust second element.

[0011] The first and second elements are preferably arranged at a mutual spacing in the vertical direction of the including vehicle. In this way, space is provided for using, for example, other parts of the vehicle frame in the construction, and the possibility is also improved for bringing about a construction in which the two elements can act independently of one another, which allows greater flexibility in, for example, selection of the first and second elements.

[0012] The device suitably also comprises a part of the vehicle

frame which serves for taking up load and is arranged serially in the vertical direction. The second element is preferably adapted to act against the part for taking up load when a certain spacing between the cab and the vehicle frame is reached. In this way, the force/load take-up of the first element can be limited to the forces/loads which arise under more moderate operating conditions, while the second element, the element for taking up load, can transmit all or some of the force/load to the part of the vehicle frame for taking up load in the event of, for example, accident situations in which the cab is forced by powerful forces in the direction away from the vehicle frame. That is to say, in a situation when the first element has been left a sufficiently long distance behind that such a spacing between the cab and the vehicle frame has been brought about that the second element is allowed to act against the part for taking up load. One advantage of this solution is that the first vibration-damping element can be constructed/selected with low strength requirements, which makes possible a simpler and more cost-effective overall construction.

[0013] The first and second elements preferably constitute separate detachable units. In this way, the possibility is pro-

vided of simply exchanging one element or the other mutually independently. In other words, it is possible to exchange a defective element or vary the type or make of one element simply without having to make any changes to the other element or adjacent parts of the cab or the vehicle frame.

[0014] The connecting means suitably comprises at least one elongate member, which member connects the first element and the cab, or alternatively the vehicle frame. The first and second elements are preferably arranged at a mutual spacing in the longitudinal direction of the elongate member.

[0015] In a further improvement of the invention, the elongate member is provided with threads with the same pitch in on the one hand the part which is intended to be screwed firmly into the first element and on the other hand the part which is intended to be screwed firmly into the cab, or alternatively the vehicle frame.

[0016] One advantage of the connecting means comprising an elongate member which connects the first element to the cab/vehicle frame is that the construction includes as few weaknesses and as little potential play as possible. By designing the elongate member with the same thread pitch

at the upper end and the lower end, the connection can be adjusted (screwed) without the spacing between the first element and the cab/vehicle frame being changed, which is advantageous from the point of view of mounting. Among other things, a possibility is provided for mounting the invention from below the cab on occasions when it is difficult to reach from above. By, for example, first screwing the elongate member up into the cab with the aid of a nut stop and then mounting the first element in the vehicle frame, the connection can then be screwed down and adjusted in the first element. This may be particularly advantageous in the case of work with older machines which from the outset were not constructed for the type of suspension device according to the invention and in which accessibility for tightening is limited.

[0017] The present invention is therefore well-suited for being mounted on older machines which from the outset were not constructed for the type of suspension device according to the invention. Furthermore, a fundamental idea of the present invention is that the two elements are to be independent of one another. Firstly, this idea concerns the functioning, that is to say the element for taking up load is not to be loaded by vibrations and shocks during nor-

mal operation, and the vibration-absorbing element is not to be loaded by the forces which may arise in accident situations. In this way, a simple and cost-effective overall construction is made possible. Secondly, this idea concerns the physical design, that is to say one element is to be simply exchangeable without any changes having to be made to the other element. This makes the construction flexible and makes it possible to adapt the construction to different situations.

Brief Description of Drawings

[0018] The invention will be described in greater detail below with reference to the following figures, in which:

[0019] Figure 1 shows a basic diagram of a perspective view of a first preferred embodiment of the invention;

[0020] Figure 2 shows an exploded diagram according to Figure 1;

[0021] Figure 3 shows another exploded diagram according to Figure 1;

[0022] Figure 4 shows a perspective view of a second preferred embodiment of the invention;

[0023] Figure 5 shows an exploded view according to Figure 4;

[0024] Figure 6 shows another exploded diagram according to

Figure 4;

[0025] Figure 7 shows a perspective view of a third preferred embodiment of the invention;

[0026] Figure 8 shows an exploded diagram according to Figure 7;

[0027] Figure 9 shows another exploded diagram according to Figure 7;

[0028] Figure 10 shows a perspective view of a fourth preferred embodiment of the invention;

[0029] Figure 11 shows an exploded diagram according to Figure 10; and

[0030] Figure 12 shows another exploded diagram according to Figure 10.

DETAILED DESCRIPTION

[0031] The figures below do not show a complete cab or vehicle frame, but these components are represented by small part-areas located close to the attachment points of the suspension device. Such a part-area may consist of, for example, part of a cab beam. The suspension of the cab normally comprises four suspension devices. The cab is positioned above the frame, and the vertical direction of the vehicle is essentially from the bottom up in the figures.

[0032] Figures 1, 2 and 3 show the principle of a first preferred embodiment of the invention. A first, vibration-damping element 1 is mounted firmly on a vehicle frame 3 by means of, for example, a screwed joint or a welded joint. With the aid of a connecting means 5, comprising an elongate member 8 and two nuts, the first element 1 is connected firmly to a cab 4, that is to say the first element 1 is connected firmly to the cab 4 via the connecting means 5. A second element 2, the element for taking up load, is arranged firmly on the elongate member 8 of the connecting means 5. The first and second elements 1, 2 are thus arranged serially in the vertical direction of the vehicle. Vibrations in the vehicle frame 3 are damped in the first element 1 and are transmitted only moderately to the connecting means 5 and thus the cab 4. The second element 2 vibrates with the connecting means 5 and, under more moderate operating conditions, will not come into any appreciable contact with the vehicle frame 3. In the event of a sufficiently forceful shock which causes the cab 4 and the connecting means 5 to move in the direction away from the vehicle frame 3, which may occur if, for example, the vehicle overturns, the second element 2 will act against a serially arranged part 7 (see Figure 3) on

the vehicle frame 3 for taking up load and in this connection retain the cab 4 in place. When the second element 2 begins to act against the part 7 on the vehicle frame 3 for taking up load, the load/force which the first element 1 has to take up is limited. The invention can be adapted so that the second element 2 also takes up loads/forces in the lateral direction(s) of the vehicle in a corresponding way to in the vertical direction of the vehicle.

[0033] The expression that a connection (or mounting etc.) is firm means in principle that the connection is intended for transmitting forces and thus requires some form of fastening such as a welded joint, screwed joint, riveted joint, adhesively bonded joint etc. The type of loose connection formed, for example, when a cab rests on a first element in the form of a "rubber collar" and exemplified in, for example, US 5064242 is therefore not intended.

[0034] The top side provided of the second element 2 is suitably with, for example, rubber in order to obtain a softer action against the part 7 for taking up load. The sides connecting means 5 and/or the sides in the hole through the part 7 in the vehicle frame 5 for taking up load can also suitably be provided with the rubber in order to take up shocks and vibrations in the lateral direction(s) of the ve-

hicle.

[0035] Figures 4, 5 and 6 show a second preferred embodiment of the invention. Figures 7, 8 and 9 show a third preferred embodiment of the invention. Figures 10, 11 and 12 show a fourth preferred embodiment of the invention. The three figures for each embodiment complement one another. The previous description of the first embodiment (Figures 1-3) can in the main also be applied to these three embodiments as, in principle, they have the same construction. What distinguishes the different embodiments is chiefly the design of the connecting means 5 which, as can be seen in Figures 4-12, consists of a large number of different components such as bolts, nuts and washers.

[0036] The main purpose of the first element 1 is to reduce/eliminate transmission of shocks and/or vibrations from the vehicle frame 3 to the cab 4, while the main purpose of the second element 2 is to take up loads in the event of, for example, accident situations and therefore to function as ROPS protection. Reducing/eliminating transmission of shocks and vibrations can comprise both insulation and damping, for which reason the first element can have both insulating and damping characteristics. Expressions such as vibration damping, vibration damper, vibra-

tion element etc. mean the function or the element which relates to the main purpose of the first element 1.

[0037] The first element 1 is preferably of the "viscous mount" type with both vibration-insulating and damping characteristics. This type normally comprises a rubber spring and a device in which work losses are generated in a suitable manner. This device preferably contains a liquid such as, for example, silicone oil or glycol, which liquid is, for example, forced to pass through throttlings. Alternatively, use can be made of a construction which utilizes the work losses in an elastic material such as, for example, rubber. One reason why such "viscous mounts" have better vibration-damping characteristics than "rubber collars" is that the former not only vibration-insulate at high vibration frequencies but can also be designed so that they damp resonant vibrations brought about by, for example, shock sequences. In terms of construction, "rubber collars" and "viscous mounts" differ considerably because they have to be arranged in different ways.

[0038] It is common to the different embodiments that the second element 2 is arranged firmly on the connecting means 5 in a position between the first element 1 and the vehicle frame 3 (see, for example, Figures 1, 4, 7 and 11). The

second element 2 consists of a disk-shaped or plate-shaped member. The second element 2 can of course be designed in a different way; for example, a number of disks or plates can be included.

[0039] Figures 6 and 12 also show the threads 9 of the elongate member 8, with the same pitch in on the one hand the part which is intended to be screwed firmly into the first element 1 and on the other hand the part which is intended to be screwed firmly into the cab 4, or alternatively the vehicle frame 3.

[0040] In the event of difficulties in reaching to work from the cab, it is possible in principle to block up the cab 4 in the correct position, and then, in a nut with a nut stop on the top side of the beam of the cab 4, to screw the elongate member 8 (see Figs 3-6) up into the cab 4 as far as necessary in order for it to be possible to mount the first element 1 on the vehicle frame 3, the rest of the connecting means 5 and also the second element 2. Owing to the fact that the pitch of the thread 9 is the same at both ends, the elongate member 8 can then be screwed down into the first element 1 without the spacing between the cab 4 and the first element 1 being changed. Vertical adjustment of various suspension devices of the cab 4, for ex-

ample, is then simple to perform.

[0041] The invention is not limited to the illustrative embodiments described above, but a number of modifications are conceivable within the scope of the patent claims below. For example, all the embodiments show a construction in which the first element 1 is connected firmly on the vehicle frame 3 and the connecting means 5 constitutes a firm connection between the first element 1 and the cab 4. However, it is entirely possible instead to connect the first element 1 on the cab and to have the connecting means 5 constitute a firm connection between the first element 1 and the cab 4. However, it is entirely possible instead to connect the first element 1 on the cab and to have the connecting means 5 constitute a firm connection between the first element 1 and the vehicle frame 3. In this alternative case, the second element 2 must of course be arranged firmly on the connecting means 5 in a position between the first element 1 and the cab 4, and then act against a part on the cab 4 for taking up load, in order to have an effect.